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PATENT SPECIFICATION

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PROVISIONAL SPECIFICATION

Improvements in or relating to Materials for Bearing Surfaces

We, THE GLACIER METAL COMPANY LIMITED, of 368, Ealing Road, Alperton, Wembley, in the County of Middlesex, a British Company, GEORGE COHEN SONS & COMPANY LIMITED, of Broadway Chambers, Hammersmith, London, W.6, a British Company, and WILLIAM HENRY COLLINGBOURNE, a British Subject, of the latter Company's address, do hereby declare the nature of this invention to be as follows:—

This invention relates to materials for bearing surfaces, which are suitable for any kind of bearings, bushes, journals and thrust washers.

The most essential properties of a bearing surface, whether that of a journal bearing associated with a journal rotating or reciprocating inside it, or of a flat thrust face bearing up against another thrust face in such a manner that the two contacting faces move relatively to each other, are low coefficient of friction, and resistance to wear particularly when lubrication by oil or grease is scanty or possibly non-existent. In addition a good bearing surface will possess a certain degree of conformability so that it may accommodate such slight variations in alignment as occur in practical operation.

Among the many materials in use for bearing surfaces, a considerable proportion is found to possess a duplex structure of a kind in which relatively hard, flat faced particles are embedded in a softer matrix. Examples are the white metal alloys, commonly called Babbitt metals, in which hard cuboids of an antimony-tin compound are embedded in a relatively soft tin-rich solid solution; and tin bronzes in which a hard delta constituent is embedded in a relatively soft copper-tin solid solution. The hard particles are formed as a result of metallurgical changes during cooling and for this reason it is not possible to vary greatly the mechanical properties of the two constituents, the hard particles and the softer matrix. It is also difficult to control the relative proportions of the two constituents and the size of the hard particles, since small changes in the mechanism and timing of the cooling may profoundly influence the final structure.

This invention has for its object to produce such a composite material having a soft matrix and hard particles incorporated therein and in which the hard particles possessing both extreme hardness and a surface possessing a low coefficient of friction when used in contact with either the same hard material alone or in composite form, or with steel or with other materials used for journals or thrust faces in engineering practice, within a wide range of lubrication conditions.

According to this invention we take as starting materials hard particles and a relatively soft matrix material and we mechanically incorporate the hard particles in the relatively soft matrix. The duplex structure thus formed can be varied widely to suit different circumstances: the hard particles can be chosen for the properties and dimensions that are desired: the relatively soft matrix may be selected, adjusted or compounded to possess any of a wide range of mechanical properties, and the relative proportions of the two may be varied. It will be obvious that the hard particles must be insoluble in the matrix at the temperatures required for sintering.

Examples of these hard particles are the sintered composite carbides, known generally as "cemented carbides" developed for use in cutting tools. These composite materials contain carbides of tungsten, titanium, or tantalum, bonded with cobalt or nickel by heat treatment in a controlled atmosphere, and may contain the carbides and bonding metals in a wide range of proportions. All, however, are characterised by great hardness and good bearing surface properties. Other hard particles besides the cemented carbides can be used provided they possess the same physical characteristics, for example, certain borides or silicides.

The particles of cemented carbide may be produced, by crushing presintered cemented carbide. The size of particle may vary according to the application.

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but a generally useful assortment would be able to pass through a 60 mesh I.M.M. screen, but would be retained on a 200 mesh.

For the relatively soft matrix we prefer copper or an alloy of copper and tin, which may contain, in addition, lead up to 40% and in which the tin may vary between 0.25 and 15%. Alternatively we may use zinc or zinc alloys; tin or tin alloys; lead or lead alloys, aluminium or any other soft metal or alloy.

We prefer to prepare the composite material by sintering, that is, by heat treatment in a controlled reducing atmosphere at a temperature below the melting point of that of the most refractory constituent.

As an example of one method of manufacture, we mix the hard particles in the ratio of 1.4 by weight with powdered bronze alloy containing copper 80% tin 10% lead 10% and we spread this, without heavily compacting it, on a copper plated steel blank or strip. The coated strip is then heated at a temperature of 850°C. in an atmosphere of hydrogen for a period of 15 minutes and is then allowed to cool in the same atmosphere. It will then be found that the mixed powders are firmly bonded together and to the steel base. The powders will form a porous mass which may be compacted by pressing or rolling and may be retreated by re-sintering in a reducing atmosphere. Finally, the surface may be smoothed and trued by grinding or planishing.

The composite strip, so made, may be blanked and machined to form flat thrust members, or may be bent and machined to form journal bearings.

One alternative method is first to spread an even layer of bronze powder onto the plated strip and then to sprinkle the cemented carbide powder, either alone or mixed with more bronze powder, onto the surface. The whole is then sintered as in the first example quoted above.

It must be realised that the above two cases are given as examples only. We may vary the composition of the soft matrix, and the ratio of cemented carbide to bronze. Our sintering temperature will be varied to suit other conditions and our reducing atmosphere can vary widely in composition. The essential features of the invention are the production of a composite material containing hard particles dispersed in a relatively soft metallic matrix, this composite material being particularly adapted to the manufacture of thrust washers and journal bearings and bushes.

Dated this 31st day of July, 1945.

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COMPLETE SPECIFICATION

Improvements in or relating to Materials for Bearing Surfaces

We, THE GLACIER METAL COMPANY LIMITED, of 368, Ealing Road, Alperton, Wembley, in the County of Middlesex, a British Company, GEORGE COHEN SONS & COMPANY LIMITED, of Broadway Chambers, Hammersmith, London, W.6, a British Company, and WILLIAM HENRY COLLINGBOURNE, a British Subject, of the latter Company's address, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to materials for bearing surfaces, which are suitable for any kind of bearings, bushes, journals and thrust washers.

The most essential properties of a bearing surface, whether that of a journal bearing associated with a journal rotating or reciprocating inside it, or of a flat thrust face bearing up against another thrust face in such a manner that the two contacting faces move relatively to each other, are low co-efficient of friction, and resistance to wear particularly when lubrication by oil or grease is scanty or possibly non-existent. In addition a good bearing surface will possess a certain degree of conformability so that it may accommodate such slight variations in alignment as occur in practical operation.

Among the many materials in use for bearing surfaces, a considerable proportion is found to possess a duplex structure, of a kind in which relatively hard, flat faced particles are embedded in a softer matrix. Examples are the white metal alloys, commonly called Babbitt metals, in which hard cuboids of an antimony-tin compound are embedded in a relatively soft tin-rich solid solution; and tin bronzes in which a hard delta constituent is embedded in a relatively soft copper-tin solid solution. The hard particles are formed as a result of metallurgical changes during cooling and for this reason it is not possible to vary greatly the mechanical properties of the two constituents, the hard particles and the softer matrix. It is also difficult to control the relative proportions of the two constituents and the size of the hard par-

ticles, since small changes in the mechanism and timing of the cooling may profoundly influence the final structure.

This invention has for its object to produce a thrust washer or bearing liner of a composite material in which the bearing surface is constituted by particles of hard metallic substance, such as a metal carbide, incorporated in a relatively soft matrix.

It is known, in the production of cast or moulded machine and like parts having wear-resisting qualities, to incorporate particles of tungsten carbide or the like in a bronze matrix. It is also known, in the production of similar composite materials for other purposes not including bearings, to incorporate hard particles, such as metal carbides, into a bronze or like matrix, by sintering a mixture of the hard particles with metal powder and subjecting the mixture in some cases to the application of pressure before and/or after the sintering operation, which may be carried out in a protective atmosphere, for example, in the presence of hydrogen.

According to the present invention, a process for manufacturing a thrust washer or bearing liner comprises applying a layer comprising hard particles of pre-sintered metal carbide or carbides and a softer metal in the form of powder on a steel backing strip, and subjecting the layer to sintering in an inert or reducing atmosphere to produce a composite material. In order to obtain a bearing surface of the desired porosity, a suitable degree of pressure is applied to the said layer during and/or after the sintering operation. The hard particles preferably are of cemented carbide or carbides.

The composite material produced is subsequently shaped and machined to form a thrust washer or bearing liner.

The invention is hereinafter described by way of example with reference to the accompanying drawing, in which:—

Fig. 1 is a plan and Fig. 2 is a section of a fragment of one form of composite strip bearing material according to the present invention; and

Fig. 3 is a sectional view of a modified structure.

As an example of one method of manufacture, the hard particles of sintered carbide 1 are mixed in the ratio of 1 to 4 by weight with powdered bronze alloy 2 containing copper 80% tin 10% and lead 10% and then spread, without heavily compacting it, on a copper plated steel blank or strip 3. The coated strip is then heated to a temperature of 850°C. in an atmosphere of hydrogen for a period of 15 minutes and is then allowed to cool in the same atmosphere. It will then be found that the mixed powders are firmly bonded together and to the steel base, the powders having formed a porous mass which may be compacted by pressing or rolling and may be re-treated by resintering in a reducing atmosphere. Finally the surface may be smoothed and trued by grinding or planishing. In the finished article, as will be seen from Figs. 1 and 2, the particles of sintered carbide 1 are substantially evenly distributed through the structure.

The composite strip so made may be so blanked and machined to form flat thrust members, or may be bent and machined to form journal bearings.

The modified form of composite bearing metal strip shown in Fig. 3 is made by an alternative method which is first to spread an even layer of the bronze powder 2 onto the plated strip 3 and then to sprinkle the cemented carbide powder 1, either alone or mixed with more bronze powder 2, onto the surface, the quantity depending on the ratio in the finished surface of hard to soft particles desired. The whole is then sintered as in the first example quoted above. In this modified form the sintered carbides are only disposed in or near the bearing surface.

It must be realised that the above two cases are given as examples only. The composition of the soft matrix and the ratio of cemented carbide to bronze may vary. The sintering temperature may be varied to suit other conditions and the reducing atmosphere can vary widely in composition. The duplex structure thus formed can be varied widely to suit different circumstances; the hard particles can be chosen for the properties and dimensions that are desired; the relatively soft matrix may be selected, adjusted or compounded to possess any of a wide range of mechanical properties, and the relative proportions of the two may be varied. It will be obvious that the hard particles must be insoluble in the matrix at the temperatures required for sintering.

Examples of these hard particles are the sintered composite carbides, known generally as "cemented carbides" developed for use in cutting tools. These composite materials contain carbides of tungsten, titanium, or tantalum, or mixtures of these metals, bonded with cobalt or nickel by heat treatment in a controlled atmosphere, and may contain the carbides and bonding metals in a wide range of proportions. All, however, are characterised by great hardness and good bearing surface properties.

The particles of cemented carbide may

be produced by crushing presintered cemented carbide. The size of particle may vary according to the application, but a generally useful assortment would be able to pass through a 60 mesh I.M.M. screen, but would be retained on a 200 mesh.

For the relatively soft matrix it is preferred to use copper or an alloy of copper and tin, which may contain, in addition, lead up to 40% and in which the tin may vary between 0.25 and 15%. Alternatively, zinc or zinc alloys, tin or tin alloys, lead or lead alloys, aluminium or any other soft metal alloy may be used.

The composite material made according to this invention is particularly applicable to bearing or thrust service where lubrication is meagre, intermittent or unreliable.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A process of manufacturing a thrust washer or bearing liner, which comprises applying a layer comprising hard particles of pre-sintered metal carbide or carbides and a softer metal in the form of powder, on a steel backing strip, and subjecting the layer to sintering in an inert or reducing atmosphere to produce a composite material.

2. A process according to Claim 1, wherein the hard particles consist of cemented carbide or carbides.

3. A process according to Claim 1 or Claim 2, wherein the composite material is subsequently shaped and machined to form a thrust washer or bearing liner.

4. A thrust washer or bearing liner or a composite material therefor, manufactured by the process substantially as hereinbefore described.

Dated this 3rd day of June, 1946.

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[This Drawing is a reproduction of the Original on a reduced scale.]

Fig. 1.

Fig. 2.

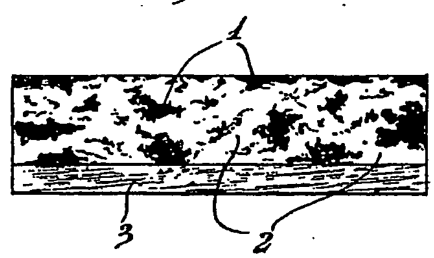

Fig. 3.